Name: _____ Section: _____ Date: _____

Worksheet - Exp 13: Electrostatics

Objective: This lab will qualitatively study electric charge transfer.

Theory: There are two kinds of charges in nature: positive charge carried by protons and negative charge carried by electrons. An object that has an excess of either is said to be charged. Like charges repel each other, and unlike charges attract.

Charge transfer is the exchange of charges between objects. In this experiment, only electrons are exchanged while protons remain stationary. These electrons may move around within materials or move between materials, but they can never be created or destroyed. This is known as the law of **conservation of charge**.

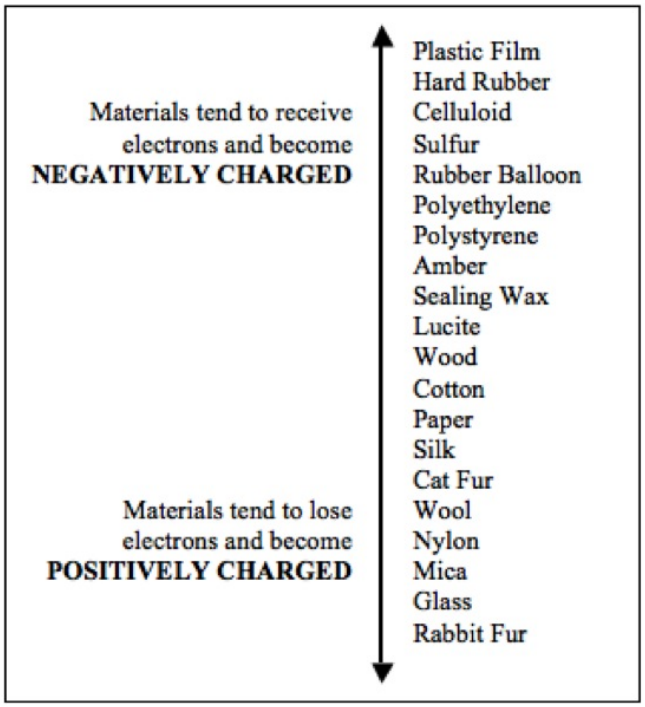
Conductors

- Conductors are objects that allow the free flow of electrons between the atoms in the material, enabling the electrons to travel throughout the object.
- Charges are easily transferred between conductors.
- Charge can collect at one end of a conductor in the presence of other charged objects.

Insulators

- An insulator is a material in which electrons are tightly bound to the nucleus.
- Transferring charge between insulators requires an extra force, e.g. friction, and direct contact.
- Insulators brought near other charged objects experience **polarization**, a shifting of electrons to one side of an atom.

Rubbing insulators together produces a transfer of electrons which leaves one object charged positively (fewer electrons) and one charged negatively (excess electrons). Insulators tend to acquire charge according to the following **electrostatic series** (Table 13.1).



Procedure:

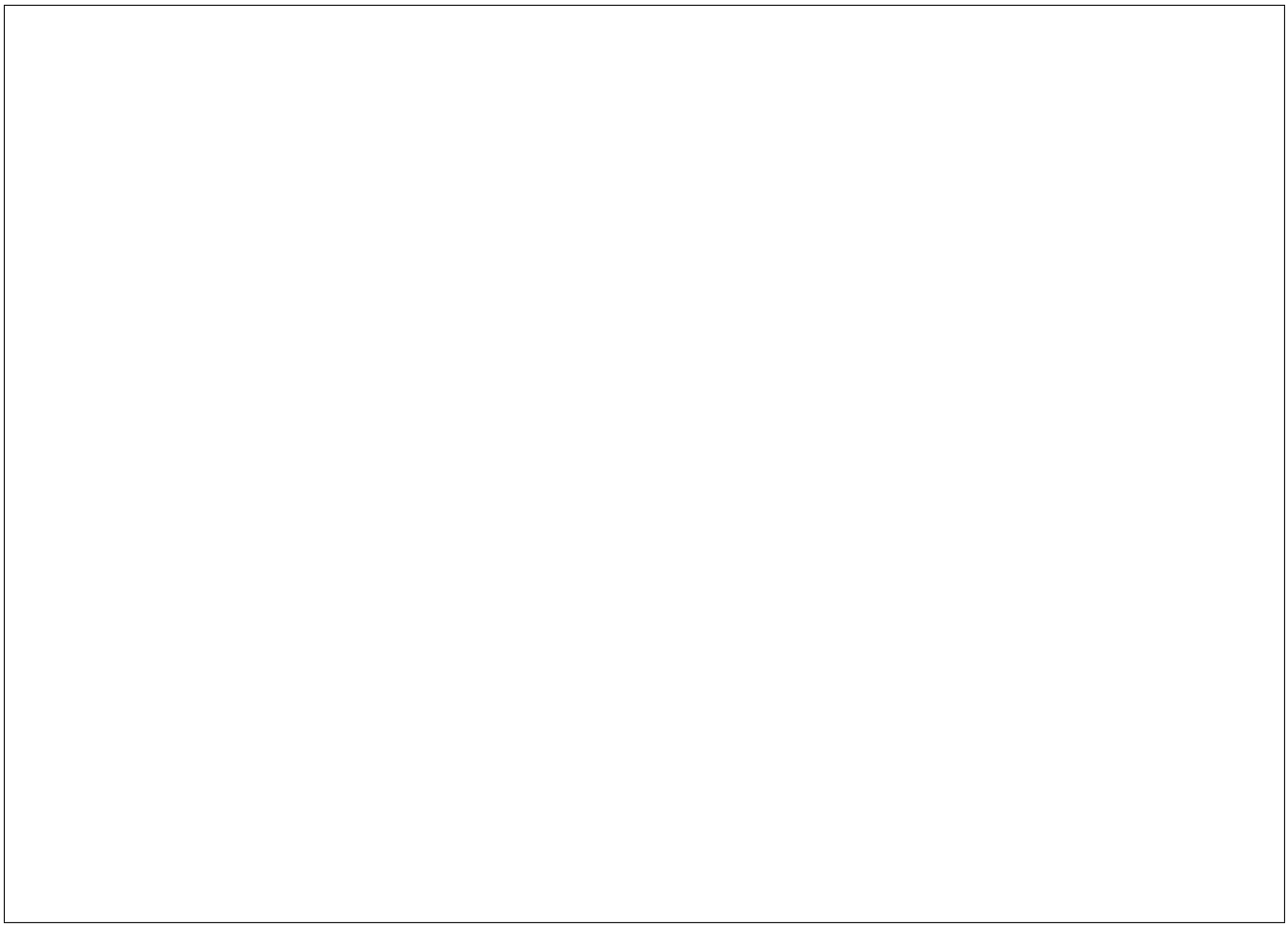
Part 1: Charging by Conduction - *Negative by Conduction*

1. Charge a rod negatively by rubbing it with a material that will give it extra electrons.
2. Bring the negatively charged rod close to the electroscope bulb without touching it. Observe how the leaves of the electroscope repel each other.
3. Touch the charged rod to the electroscope. Observe the behavior of the electroscope during conduction and as you remove the rod.
4. Draw a series of sketches showing the movement of charges during this process. (12 pts)

5. Explain what causes the leaves to repel each other before the rod contacts the bulb. How can this occur before electrons are conducted to the electroscope? In your answer, consider the charges in the electroscope and their behavior within a conductor. (12 pts)

Positive by Conduction

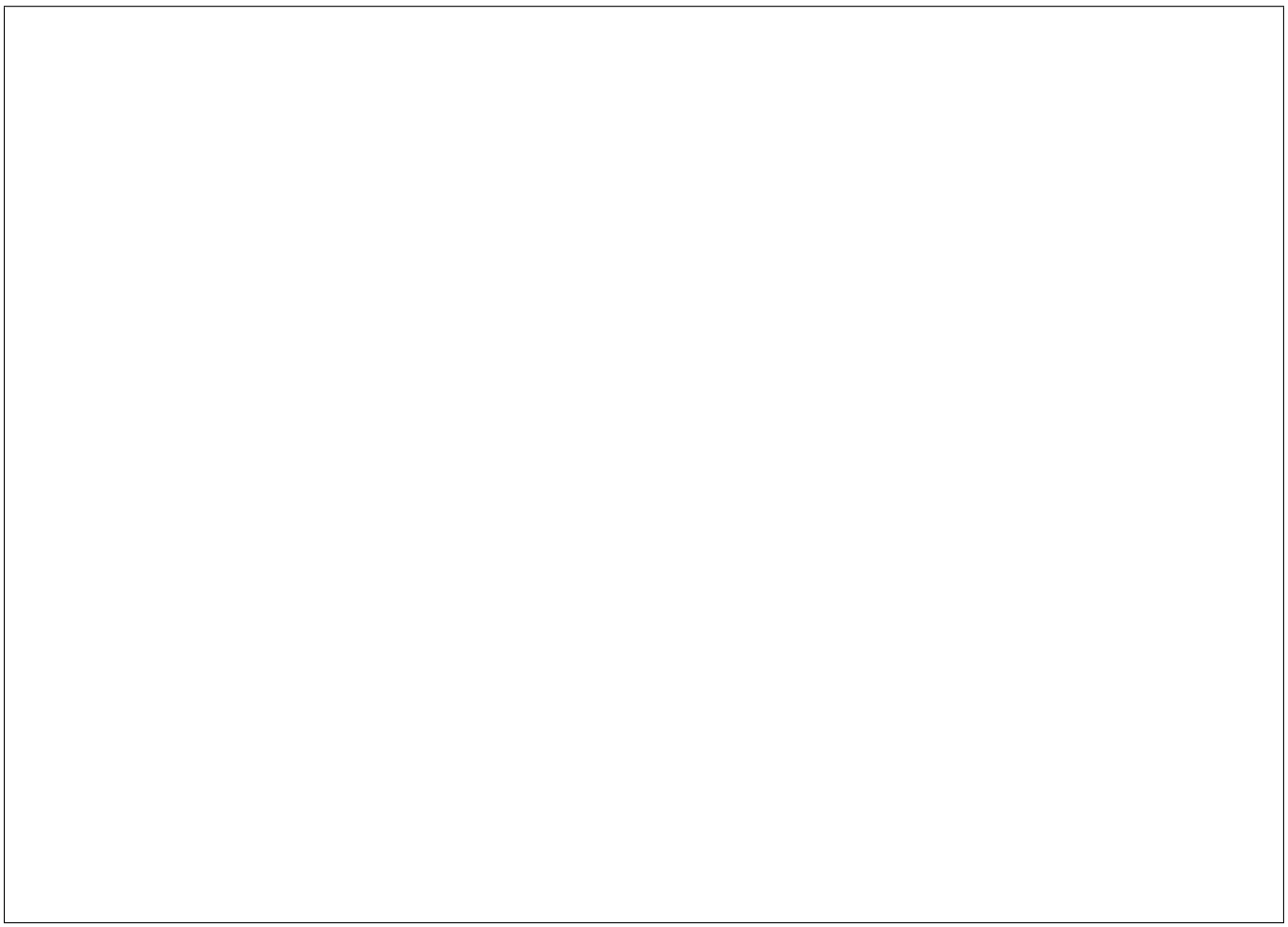
6. Charge the electroscope positively by conduction using a glass rod.
7. Sketch the various stages of this process. (12 pts)



8. What is different about electron flow when charging the electroscope positively? What causes the leaves to repel each other in this case? (12 pts)

Part 2: Charging by Induction - *Positive by Induction*

9. Bring a negatively charged rod close to the electroscope, but do not touch it.
10. While the electroscope's leaves are separated, touch the electroscope bulb with your finger to ground it. Remove your finger.
11. Remove the charged rod from the vicinity of the electroscope; observe its final state.
12. Draw a series of sketches showing the movement of charges during this process. (12 pts)



13. What is the final state of the electroscope if you remove the rod before removing your finger? What causes this? (12 pts)

Negative by Induction

14. Charge the electroscope negatively by induction. Which rod will charge the electroscope negatively by induction?

    _____ (4 pts)

15. Sketch the various stages of this process. (12 pts)

16. Your finger acts as a ground, or large reservoir of charge, that allows the **system** (rod and electroscope) to reach neutral (leaf down). If the rod has a positive charge, what must be the charge of the electroscope when the rod/electroscope system is brought to neutral? Does it have an excess of electrons, a deficit, or neither? How do you know? (12 pts)